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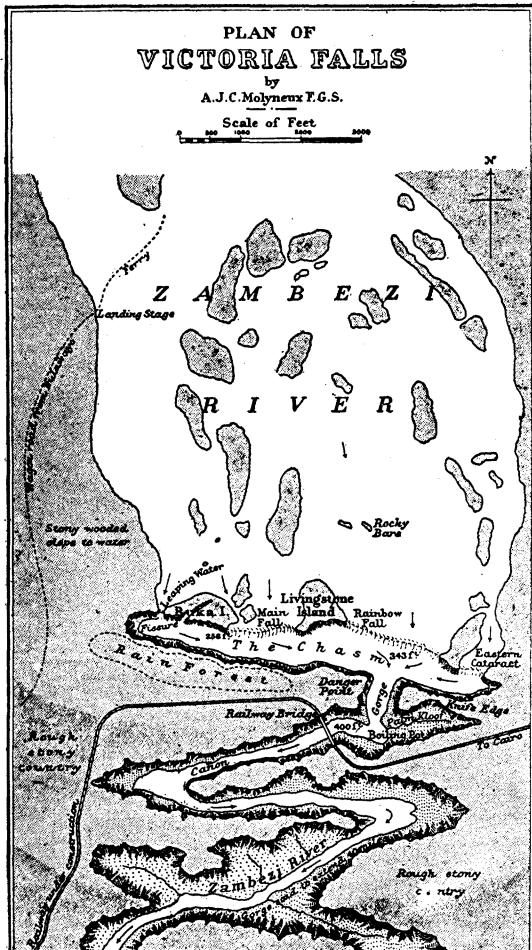
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THE VICTORIA FALLS OF THE ZAMBEZI.

Mr. A. J. C. Molyneux has a very interesting article in the *Geographical Journal* (January, 1905) on the physical history of the Victoria Falls. He expresses the opinion that the theory of Dr. Livingstone that a deep fissure was opened in the earth's crust across the bed of the Zambezi, the Victoria Falls being the result of this convulsion of Nature, is not correct, though still generally accepted. "I hold the firm conviction," says the writer, "that here, no less than at Niagara, the combination of canon, gorge, chasm, and falls is due to the ever-reducing action of moving water, eating back with relentless energy, year by year, and age after age, into the hard and stubborn wall of igneous rock."

The article is illustrated with some fine views of the Falls. The accompanying map is reproduced from the *Geographical Journal*, in reduced size.



In his paper Mr. Molyneux applies names as follows: "The Chasm" is the cleft into which the river falls; "The Gorge" (that is, the throat) is the exit as far as the "Boiling Pot"; then the "Grand Cañon" commences and extends for 40 miles.

Summing up the various features of the Falls, Mr. Molyneux says that the chasm across the river is little more than 1,860 yards long—the same as the breadth of the river—that number being fixed upon as indicating the year in which the Falls were first carefully observed. The lip of the Falls is subdivided by natural features, as follows:

Nearest to the right bank is the misnamed "Devil's Cataract" ("Leaping Water" of Baines), 36 yards wide—a sloping mill-race that carries much water when many other portions are dry at low water. Next comes the island of Boaruka, about 200 yards wide, cut by a stream and fissure through which water pours at flood times; then comes the Great Fall, 573 yards broad, divided from a second fall of 325 yards by a projecting rock. At the east end of this fall is Garden Island, now known as Livingstone Island, lying on the very edge of the precipice, some 1,170 yards from the west side and 600 yards from the east shore. At the end of the chasm is the Eastern Cataract, a mill-race something similar to the "Leaping Water." This part of the Falls east of the island is mostly bare in the time of low water, and then gives passage to many isolated and narrow streams. The west end of the chasm is but 256 feet deep, as measured by Mr. Mansergh, the railway engineer, increasing to 343 in depth at the orifice of the chasm and increasing to 400 feet below the Boiling Pot. The chasm near each end is not more than 80 or 100 feet wide, increasing to 240 feet in the centre.

The water dropping over the Falls nearest the banks has now to turn at right angles and run the gauntlet past that falling over the centre, for the only outlet is the gorge of about 100 feet in width. Here, again, the right angle is in evidence, and the southerly course is now resumed. But not for long; 130 yards farther it enters the Boiling Pot, and emerges therefrom to run in a trench of 1,170 yards long parallel to the first. Only the portion of this parallel trench west of the Boiling Pot is occupied by the stream, the eastern end being now dry, and nursing in its sunlit depths the vegetation of the Palm Kloof. This end is divided from the chasm by a very narrow ridge of rock called the Knife Edge, the western end by a wide promontory (on which river pebbles can be found), with a base 416 yards wide, now carrying the Rain Forest. In the

writer's opinion this is an old Falls chasm, dating from a time when the river passed over the ridge now occupied by the Rain Forest promontory, Danger Point, and the Knife Edge, the depression at the east end of which is the extension of the eastern cataract.

At the land end of the Rain Forest promontory the cañon takes a bend at an acute angle to the east in a third cleft, then glides round a third promontory to form a fourth chasm running westward. Beyond this the zigzag course continues, and little is then known of its vagaries through the forty miles of the Grand Cañon.

In considering the processes which formed the falls, Mr. Molyneux says that the river has removed the upper strata of fine sandstones, and consequently the level of the stream, the lower flats of the valley, the ends of the chasm, and the edges of the gorge and cañon can be seen to be of the same horizon of basaltic rock (Columnar). The apron of water and inaccessibility prevent one seeing if the hard-top sheet extends in depth for the whole 400 feet of the chasm, but down the cañon it can be noticed that the lava lies in beds of varying thickness. The examination of these strata is not possible unless one is slung over the precipice—a feat not yet attempted. The hard surface is a basalt more or less amygdaloidal, on the degree of which quality depends its want of tenacity.

As is common to all rocks of this nature, it is full of cracks and fissures, due to contraction on cooling, and though it does not assume the perfectly regular hexagonal columns of the Giant's Causeway, or of Staffa, yet it frequently resembles them, the vertical cracks producing a general columnar form. The columns thus defined may be seen when the water is low, along the lip of the falls and beneath the clear and rushing current of the "Leaping Water" (Devil's Cataract), more or less truncated as the verge is reached, and bearing but little evidence of attrition. Indeed, evidence of actual wearing away of the angular edge of the precipice is conspicuously absent, and the level of the stream is almost unchanged up to the very lip of the falls. Only at the two cataracts at the ends of the chasm can the process of trituration be called in aid as a demolishing agent, and even here it is probable that the columns have been truncated by the action of the rushing water forced into the horizontal joints.

Mr. Molyneux believes that the cutting back of the edge is due to the perpetual hammering action of the vast bodies of water falling into and down upon the cracks between the basalt columns, assisted by the constant vibration of the rock from the precipitated

masses of water, and that by this constantly exerted force the columns are rent asunder and fall into the chasm, taking with them huge and deep flakes of the precipice. At low-water heaps of these blocks, as yet angular and unreduced, may be seen in the shallower ends of the chasm.

While there are signs some distance away that the basalt-flows are bedded in various degrees of tenacity, there is no sign of undermining of the rock that forms the rim, as at Niagara, and so leaving that rim without support; rather does the lower portion of the precipice at places protrude outwards. But the breaking down of the rock is mostly columnar; hence the almost vertical walls of falls, chasm, gorge, and cañon.

The writer thinks such are the causes that have played the most important rôle in the trenching of this length of forty miles.

EARTHQUAKES IN JAPAN.

The number of earthquakes in Japan in the year 1903 was 1,349. The *Publications of the Earthquake Investigation Committee*, No. 19, says that this is by no means more than the annual average. While Japan is pre-eminently a land of earthquakes, the shocks that are sufficiently severe to cause loss of life or serious damage to property are not numerous when compared with the total number of movements. Since 1872 fifteen earthquakes in Japan have been attended with serious consequences. It is only within a comparatively short time that the invention of the seismograph has made it possible to take note of the minor shocks; but over 2,000 earthquakes were recorded in the history of Japan between 416 and 1867 of the Christian Era.

The accompanying map is taken from No. 19 of the *Publications*. It shows the distribution of earthquakes that have caused loss of life and large destruction of property in Japan from the Fifth Century to the present time. There have been in all 223 of these violent earthquakes; 149 were limited in their destructive effects to one province of the empire and 74 extended over two or more provinces. Destructive earthquakes on the concave or Japan Sea side of the archipelago, as a rule, have smaller extent than those which occur on the convex or Pacific side. Of the 223 destructive